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The body size distribution of *Filinia longiseta* (Ehrenberg) in different types of small water bodies in the Wielkoposka region

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ABSTRACT

The body size distribution of *Filinia longiseta* (Ehrenberg) in different types of small water bodies in the Wielkoposka region

Small water bodies are often characterised by specific macrophyte species composition and different levels of predation. This may also have an effect on the body size and shape of rotifer specimens. The aim of the study was to determine the relation of the size of rotifer *Filinia longiseta* (body and appendages length), with respect to three specific kinds of pond (mid-forest, pastoral and anthropogenically changed) and to three kinds of hydromacrophytes (nymphaeids, elodeids and helophytes) as well as comparatively to the open water zone. The examined water bodies also differed in fish presence or absence. Morphometric analysis of specimens of *F. longiseta* showed that both factors –the type of water body relating to different land-use in the catchment area as well as the microhabitat type– were significant predictors, influencing their body size and spine length. *Filinia longiseta* specimens were significantly smaller in ponds situated within the pastoral catchment area. The largest specimens were found among stands of nymphaeids, while the smallest were found within the open water zone, which may indicate both the ecological requirements of this species as well as the marked influence of fish in the unvegetated area.

Key words: Body size, *Filinia longiseta*, rotifers, ponds, macrophytes.

RESUMEN

Distribución de tamaños de Filinia longiseta (Ehrenberg) en diferentes tipos de pequeñas masas de agua en la región de Wielkoposka

Las pequeñas masas de agua están caracterizadas a menudo por la composición específica de macrófitos y diferentes niveles de depredación. Esto puede tener efecto en el tamaño y la forma de los rotíferos. El objetivo de este estudio fue determinar las diferencias de tamaño (longitud del cuerpo y de los apéndices) del rotífero Filinia longiseta *en tres tipos de charcas (forestales, de pastizales y antropizadas) y en tres tipos de vegetación sumergida (ninfeidos, elodeidos y helófitos) así como también en aguas libres. Las charcas examinadas diferían también por la presencia o no de peces. Los análisis morfométricos de los individuos de* F. longiseta *han mostrado que tanto el tipo de charca, según los usos del suelo en el área de captación, como el tipo de microhabitat influencian las longitudes del cuerpo y de los apéndices. Los individuos de* F. longiseta *resultaron ser significativamente más pequeños en las charcas situadas en las zonas de pastizales. Las poblaciones con individuos de mayor tamaño se encontraron en las matas de ninfeidos, mientras que en las de aguas libres se encontraba las constituidas por individuos de menores dimensiones, lo que puede ser debido tanto a las adaptaciones de esta especie a las condiciones del medio como a la reconocida influencia de los peces en las zonas desprovistas de vegetación.*

Palabras clave: *Tamaño corporal,* Filinia longiseta*, rotíferos, charcas, macrófitos.*

INTRODUCTION

The factors which create a specific habitat character may also influence the structure of zooplankton communities (Burks *et al*., 2002; Romare *et al*., 2003). The variation of aquatic vegetation, relating to morphology and the density of a plant stand, may also lead to a higher diversity compared to the open water zone of both rotifer and crustaceans (Scheffer, 1998; Kuczyńska-Kippen, 2007a). Moreover, the occurrence and size structure of rotifers can vary between different habitat types (Kuczyńska-Kippen, 2005). The biotic parameters such as fish and invertebrate predators play an essential role in the determination of body size structures and abundance of zooplankton (Brooks & Dodson, 1965; Huchinson, 1967). Planktivorous fish present in lakes and ponds may have a size-selective grazing effect on zooplankton which leads to the elimination of the largest specimens from among zooplankton communities (Irvine & Perrow, 1992). Pelagic-associated species of zooplankton are often equipped with long spines which have been recognized as a defensive mechanism which reduces predation by tactile predators (Gilbert, 1999). Prey equipped with spines are more difficult for predators to manipulate where mouth size may be a limiting factor (Lampert & Sommer, 2001; Radwan *et al*., 2004). The development of this protective setae and the body size structure of zooplankton species can be modified by the presence/absence of fish. It has been shown that fish kairomons may also contribute to this process (Hanazato *et al*., 2001). However, Wallace (2002) states that not all kinds of rotifer appendages function by directly interfering with predatory attack. The *Filinia* genus contains species that possess movable, elongate, flexible appendages that swing, making wide, arc-like movements. After detecting disturbances in their surroundings produced by a predator or large suspension feeder (daphnids) such species exhibit a series of swift jumping movements which help them to escape.

Biotic factors such as predation and competition play an extremely significant role in the maintenance of plankton community structure (Brooks & Dodson, 1965). Not only predation but also competition between particular zooplankton species may also have a decisive effect on the structuring of the body size of particular zooplankton specimens (Gilbert & MacIsaac, 1989).

Small water bodies are specific ecosystems which function differently to large and deep lakes (Oertli *et al*., 2002) and human activity in their catchment area may have a much greater effect on the functioning of the ecosystem compared to large water bodies (Camacho *et al*., 2008). Ponds are less stable and the various roles land-use in their immediate vicinity seems to be of fundamental importance for the occupation of both plants and animals (Davies, 2005). The kind of land-use surrounding the water body may also contribute to basic parameters which are decisive for the composition and abundance of most zooplankton organisms (George & Winfield, 2002; Miller *et al*., 1997). The irregular processes that take place in a temperate climate, e.g. wind mixing or surface floods, will also influence the physical-chemical and biological parameters of water, especially in the case of shallow reservoirs (Joniak *et al*., 2000). The above mentioned factors affect the composition and abundance of rotifer community structure; in addition they also contribute to the size structure of particular rotifer species. *Filinia longiseta*, which is a common and cosmopolitan planktonic rotifer usually occurring in shallow lakes and variety of small water bodies (Nogrady, 1993; Radwan *et al.*, 2004), is known to be a valuable indicator of eutrophic waters (Karabin, 1985; Bērziņš & Pejler, 1989; Ejsmont-Karabin, 1995). Even though *Filinia* is an indicator of eutrophy, it has also been found in mesotrophic lakes (Mäemets, 1983). Although taxonomic problems in this genus are still unresolved (Sanoamuang, 1993), some authors distinguish several forms or subspecies within this species (Koste *et al.*, 1978; Radwan *et al.*, 2004), which according to Nogrady (1993) are separate species. Therefore in the present study this rotifer is described as *Filinia longiseta-complex,* including its various forms. Both the occurrence and number of zooplankton are often modified by the habitat preference of a species, this is connected with overall food conditions which occur within a particular water body (de Azavedo & Bonecker, 2003). *Filinia* species feed well on detritus, bacteria as well as on *Chlorococcales* (Koste *et al*., 1978; Nogrady, 1993; Radwan *et al*., 2004).

Therefore, the aim of this study was to determine the relationship between individuals of *Filinia longiseta* (Ehrenberg) representing different body sizes within specific types of ponds (mid-forest, pastoral and anthropogenically changed) and within different habitats (open water zone as well as within two kinds of hydromacrophytes –nymphaeids and helophytes).

MATERIAL AND METHODS

This study analyzed samples collected from 31 stations within 19 small water bodies located in the Wielkopolska region of western Poland (Table 1). At least 30 individuals of *Filinia longiseta* were measured from among ten stations in seven water bodies. The type of land-use in the catchment area, type of aquatic vegetation as well as predation pressure differed among particular ponds. The examined water bodies were classified into three groups depending on the

Table 1. Characteristics of examined ponds indicating the sampled stations. Size of the ponds stated as categories: 1-very small (<0.5ha), 2-small, 3-small/medium, 4-medium, 5-big, 6-very big (5 ha). *Características de las charcas estudiadas con indicación de las estaciones de muestreo. Tamaño de las charcas según las siguientes categorías: 1-muy pequeña (<0.5 ha), 2 pequeña, 3 pequeña-media, 4 media , 5 grande y 6 muy grande (5 ha).*

POND	NAME	DATE	CATCHMENT AREA	POND SIZE	POND DEPTH (m)	FISH PRESENCE	STATION
1	Batorowo (Poznań)	25.06.04	ANTROPOGENIC	3	0.5	ABSENT	WATER * PHRAGMITES AUSTRALIS
2	Marcelin (Poznań)	22.06.04	ANTROPOGENIC	4	3.5	PRESENT	PHRAGMITES AUSTRALIS * POLYGONUM AMPHIBIUM * WATER *
3	Św. Jerzy (Poznań)	22.06.04	ANTROPOGENIC	4	1.0	PRESENT	TYPHA ANGUSTIFOLIA * WATER *
4	Klempicz	18.06.05	ANTROPOGENIC	2	0.6	PRESENT	WATER POTAMOGETON NATANS TYPHA ANGUSTIFOLIA
5	Owcza	20.07.05	ANTROPOGENIC	5	0.5	ABSENT	CERATOPHYLLUM DEMERSUM WATER
6	Cotoń	23.06.06	FIELD	4	1.1	PRESENT	WATER *
7	Klonówiec	27.07.06	FIELD	5	3.5	ABSENT	WATER *
8	Przysieka	24.06.06	FIELD	1	1.0	PRESENT	WATER *
9	Dąbrówka	20.06.04	FIELD	3	0.7	PRESENT	PHRAGMITES AUSTRALIS POTAMOGETON PECTINATUS
10	Palędzie	25.06.04	FIELD	4	1.5	PRESENT	WATER POTAMOGETON CRISPUS
11	Piotrowo	16.06.02	FIELD	1	1.0	PRESENT	CHARA FRAGILIS
12	Tarnowo 8	12.07.06.	FIELD	2	0.8	PRESENT	NUPHAR LUTEUM
13	Tarnowo 21	18.06.05	FIELD	3	2.0	ABSENT	WATER
14	Kraj Warty	19.06.05	FOREST	4	1.5	ABSENT	WATER *
15	Gazbruchy M	10.06.04	FOREST	5	0.6	ABSENT	POA ANNUA WATER
16	Gazbruchy W	10.06.04	FOREST	6	1.0	ABSENT	SCHOENOPLECTUS LACUSTRIS POTAMOGETON LUCENS WATER
17	Hindak	09.06.04	FOREST	5	0.5	ABSENT	WATER
18	Miłkowo	18.06.05	FOREST	5	1.2	ABSENT	WATER
19	Obrzycko	17.06.06	FOREST	2	0.5	ABSENT	WATER *

* Station where *Filinia longiseta* was found in representative numbers.

character of the surrounding area: forest, field and anthropogenically modified, situated in urban places. Of the ponds in which *Filinia longiseta* was found, three were situated within the strongly anthropogenically modified city of Poznań (ponds numbered: 1, 2, 3), three water bodies were located within the pastoral catchment area (ponds numbered: 6, 7, 8) and only one within the forest catchment area (pond number: 14) (Table 1).

The aquatic vegetation in the ponds differed and represented three ecological groups: nymphaeids, elodeids and helophytes. The helophytes were represented by *Schoenoplectus lacustris* (L.), *Phragmites australis* (Cav.) Steud and *Typha angustifolia* (L.). Among nymphaeides three species were identified: *Polygonum amphibium* (L.), *Potamogeton natans* (L.) and *Nuphar luteum* (L.). The highest variety of species was recorded in the group of submerged plants: *Chara fragilis* (Desv.), *Ceratophyllum demersum* (L.), *Poa annua* (L.), *Potamogeton crispus* (L.), *Potamogeton lucens* (L.) and *Potamogeton pectinatus* (L.).

The examinated water bodies also differed with respect to fish presence. Fish were present in 8 of the 19 ponds (Table 1).

Samples were collected in the summer period between 2002 and 2005 from single-species plant stands or unvegetated stands, which are called open water stations. A plexiglass core sampler was used to sample the macrophyte-dominated stations. The collected material, taken in triplicate at each site, was concentrated using a 45-μm plankton net and was fixed immediately with 4 % formalin. The water chemistry at particular stations included total phosphorus, total nitrogen and chlorophyll *a*.

Filinia longiseta specimens were measured at the longest part of the animal's body and two spines –the lateral and also the caudal seta were measured separately in least 30 specimens in each sample.

Analysis of variance (ANOVA) with posteriori Tukey test was used to identify the differences in body size of individuals of rotifer species between particular kinds of habitats, including hydromacrophytes and the open water zone and also between particular types of water bodies (N = 303).

RESULTS

Filinia longiseta was found within seven of the nineteen water bodies and in ten of the thirty one investigated stations. An abundance of this species were found in pond 1 within the open water zone (695 ind L^{-1} ± 371 SD), pond 7 within the open water area (899 ind L^{-1} ± 255 SD) and in pond 2 in samples taken from the *Phragmi-*

Table 2. Total phosphorus-TP [mg/L], total nitrogen-TN [mg/L] and chlorophyll *a-Chl* a [μmg/L] concentration compared with density [mean ind L^{-1}], mean body length [μm] and mean seta lengths [μm] of *Filinia longiseta* in particular stations among different type of ponds. *Fóforo total TP [mg/L], nitrógeno total TN [mg/L] y clorofila* a Chl *a [μmg/L] junto con la densidad media [ind L^{-1}] y la longitud media del cuerpo y de los apéndices [μm] de* Filinia longiseta *en cada una de las estaciones de muestreo en los diferentes tipos de charcas.*

POND	CATCHMENT AREA	FISH PRESENCE	STATION	TP	TN	Chl a	Density	Body length	Lateral setae length	Caudal seta length
1	ANTHROPOGENIC	ABSENT	WATER	0.28	2.837	363.6	603	173.47	354.53	177.2
2	ANTHROPOGENIC	PRESENT	PHRAGMITES AUSTRALIS	0.04	1.258	3.85	791	174.27	497.67	261.23
			POLYGONUM AMPHIBIUM	0.03	1.485	2.57	296	208.67	579.33	244.93
			WATER	0.10	1.844	0.001	33	189.47	598.00	313.60
3	ANTHROPOGENIC	PRESENT	TYPHA ANGUSTIFOLIA	0.02	1.596	74.84	46	170.48	668.38	371.00
			WATER	0.07	1.188	9.41	69	229.47	891.07	456.13
6	FIELD	PRESENT	WATER	0.085	1.764	9.84	51	141.72	304.64	197.87
7	FIELD	ABSENT	WATER	0.46	3.204	—	899	150.13	384.53	243.03
8	FIELD	PRESENT	WATER	0.02	1.535	81.26	33	171.38	366.30	296.93
14	FOREST	ABSENT	WATER	0.17	1.240	48.65	29	184.80	767.67	384.53

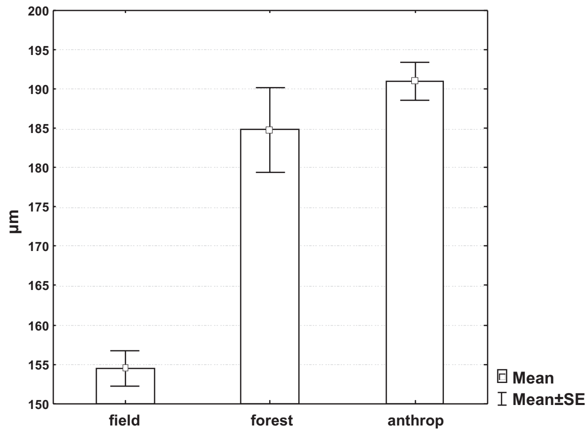

Figure 1. *Filinia longiseta* body length in different types of water bodies (forest-mid-forest, field-pastoral, anthrop-anthropogenically modified). *Longitud del cuerpo de* Filinia longiseta *en diferentes tipos de charcas (forest = forestales, field = de pastizales y anthrop = antropizadas).*

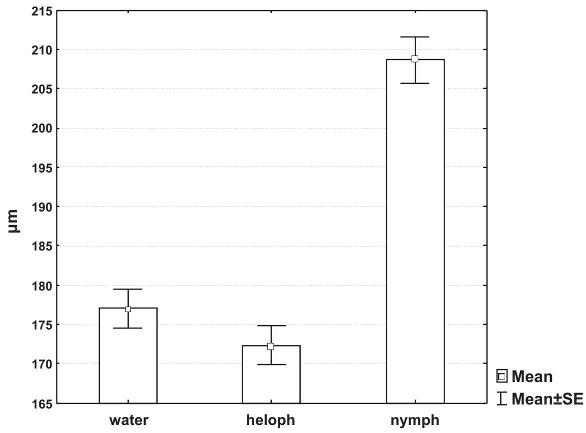

Figure 2. *Filinia longiseta* body length in different ecological habitat types (water-open water zone, heloph-helophytes and nymph-nymphides stands). *Longitud del cuerpo de* Filinia longiseta *en diferentes tipos de hábitats (water = aguas libres, heloph = helófitos y nymph = ninfeidos).*

tes australis stand (mean 791 ind L^{-1}±211 SD). The smallest abundance of *Filinia longiseta* was recorded in the open water zone in pond 6 (mean 33 ind L^{-1}±2 SD), pond 8 (mean 35 ind L^{-1}±33 SD) and in pond 14 (mean 44 ind L^{-1}±55 SD) (Table 2).

Morphometric analyses of specimens of *Filinia longiseta* included data from various stations located in seven reservoirs (pond numbers: 1, 2, 3, 6, 7, 8, 14) and showed differences in the body length value between water bodies surrounded by different types of catchment area,

Table 3. Results of Tukey tests, significance level: * <0.05, ** <0.01, *** <0.001 and ns-not significant for differences of *Filinia longiseta* body length, lateral setae length and caudal seta length among different types of ponds (forest-mid-forest, field-pastoral, anthrop-anthropogenically modified) and among different habitats (water-open water zone, heloph-helophytes and nymph-nymphaeids stands). *Resultados de las pruebas de Tukey, niveles de significación: * <0.05, ** <0.01, *** <0.001 y ns-no significativo para las diferencias en las longitudes del cuerpo, de las setas laterales y de la seta caudal de* Filinia longiseta *entre los diferentes tipos de charcas (forest-forestales, field-de pastizales, anthrop-antrópicas) y entre los diferentes habitats: water-zona de aguas libres, heloph-helófitos y nymph-ninfeidos).*

body length							
pondtype	field	forest	anthrop	mtype	water	heloph	nymph
field		***	***	water		ns	***
forest	***		ns	heloph	ns		***
anthrop	***	ns		nymph	***	***	
lateral setae length							
pondtype	field	forest	anthrop	mtype	water	heloph	nymph
field		***	***	water		***	**
forest	***		***	heloph	***		ns
anthrop	***	***		nymph	**	ns	
caudal seta length							
pondtype	field	forest	anthrop	mtype	water	heloph	nymph
field		***	***	water		ns	***
forest	***		***	heloph	ns		***
anthrop	***	***		nymph	***	***	

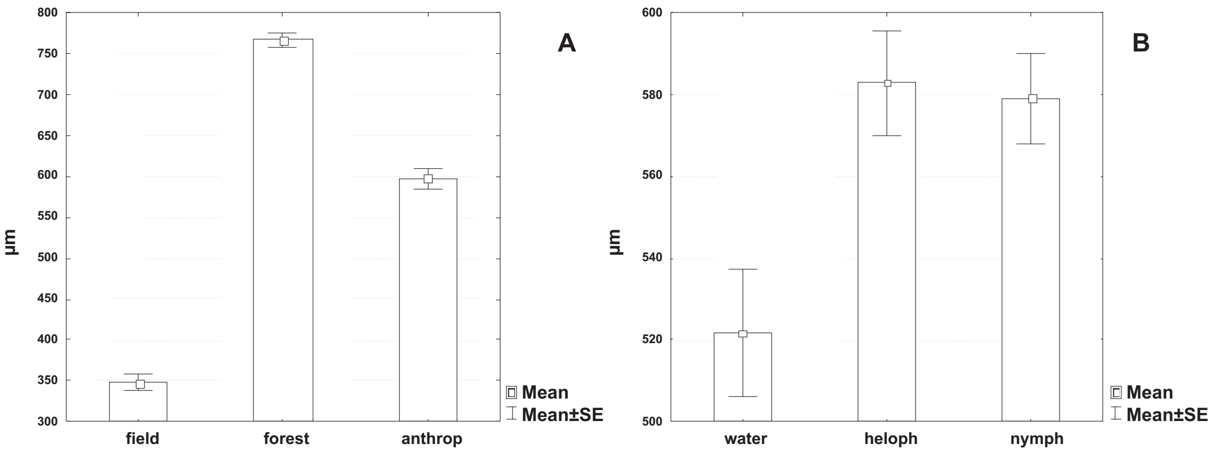

Figure 3. *Filinia longiseta* lateral setae length: (A) in different types of water bodies (as in figure 1) and (B) in various ecological habitats (as in figure 2). *Longitud de las setas laterales de* Filinia longiseta*: (A) en diferentes tipos de masas de agua (como en la figura 1) y en diferentes habitats ecológicos (como en la figura 2).*

irrespective of the examined station. The individuals of this species were significantly larger ($F = 52.3876$, $p < 0.0001$) in the anthropogenically alerted ponds and in the mid-forest reservoirs, contrary to water bodies surrounded by fields (Fig. 1, Table 3).

Comparing different types of habitat (irrespective of the type of pond) significantly smaller speecimens of *Filinia longiseta*, in relation to the body length, were noted among helophytes and the open water zone contrary to stations located within nymphaeids, where the largest individuals were found ($F = 15.0725, p < 0.01$) (Fig. 2, Table 3). No representatives of *Filinia longiseta* were found in the samples collected from among elodeids.

Morphometric analysis of lateral setae lengths also revealed variation in respect to different types of water body ($F = 321.4887$, $p < 0.01$), irrespective of habitat. The longest setae were recorded from specimens collected from forest reservoirs. The mean length values of lateral setae were found in the anthropogenically influenced

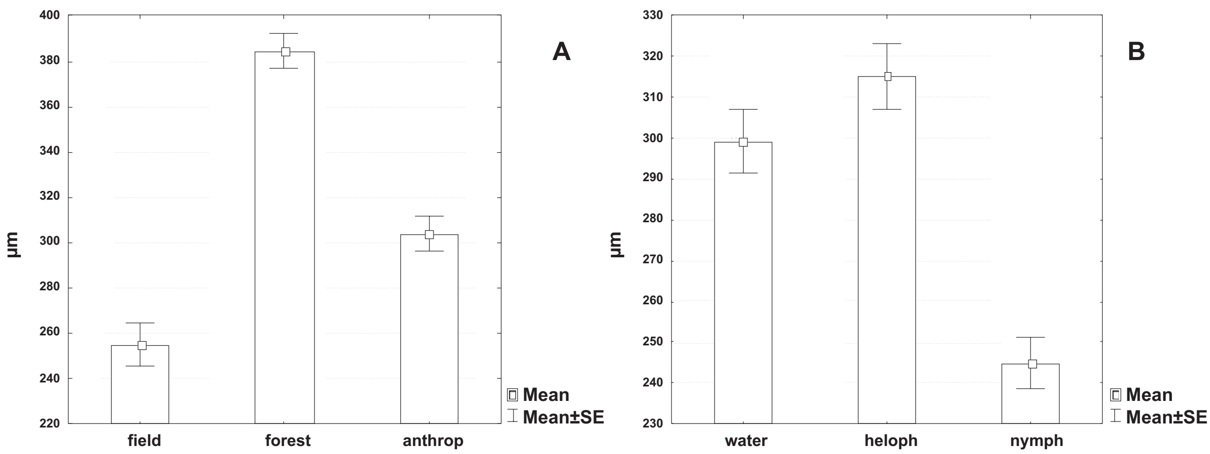

Figure 4. *Filinia longiseta* caudal seta length: (A) in different types of water bodies (as in figure 1) and (B) in various ecological habitats (as in figure 2). *Longitud de la seta caudal de* Filinia longiseta*: (A) en diferentes tipos de masas de agua (como en la figura 1) y en diferentes hábitats ecológicos (como en la figura 2).*

water bodies and significantly shorter setae of *Filinia longiseta* were observed in the case of mid-field ponds (Fig. 3A, Table 3).

A comparison among different habitat types (irrespective of the investigated types of ponds) showed that significantly shorter lateral setae of this rotifer species were recorded from among the open water contrary to the zones located within helophytes and nymphaeides ($F = 8.1299$, $p < 0.01$) (Fig. 3B, Table 3).

Biometric analysis of the length of the caudal seta of *Filinia longiseta* also revealed statistically significant differences in respect to different types of water bodies ($F = 57.78$, $p < 0.0001$). Similar to results obtained from measuring the lateral setae length, the longest caudal seta was found in the samples collected from forest ponds, while the shortest were obtained from the field water bodies (Fig. 4A, Table 3).

Analyses of caudal seta length of this species inhabiting different kinds of habitats, irrespective of the studied types of ponds revealed significant discrepancies ($F = 7.6843$, $p < 0.01$). The shortest caudal setae of *Filinia longiseta* individuals were noticed in the samples collected from nymphaeid stands and much longer setae were noted in the stations located within the open water zone and among helophytes (Fig. 4B, Table 3).

The concentration of total phosphorus, total nitrogen and chlorophyll differed between the sampled stations (Table 2). The maximal content of phosphorus was observed in pond 6 (TP = 1.41 mg L^{-1}) and pond 14 (TP = 1.06 mg L^{-1}), while the minimal concentration was recorded from all stations within pond 2 (TP = 0.01 to 0.02 mg L^{-1}). Analyzing the total nitrogen content from particular stations, a different pattern of minimal and maximal value distribution was observed compared to total phosphorus concentration. The highest total nitrogen concentration was found in pond 1 (TN = 2.84 mg L^{-1}) and pond 7 (TN = 2.10 mg L^{-1}), while the lowest was found in the case of pond 8 (TN = 1.06 mg L^{-1}). The largest differences were found between chlorophyll *a* content from among particular stations in the examined ponds. The maximal value was noted in pond 1 (363.6 mg L^{-1}), while the minimal was observed in pond 2 from among the open water zone (0.001 mg L^{-1}). In pond 5 the concentration of chlorophyll was not analyzed.

DISCUSSION

The ecological requirements of *Filinia longiseta* were confirmed in the present study, as the majority of sampled stations where it was found in representative numbers were located within the open water zone. Also the highest abundance of this species was recorded from the pelagic area of the anthropogenic pond without fish predation present (pond 1). *Filinia longiseta* is equipped with two long lateral setae which help the species to jump rapidly backwards when threatened. The lateral setae can be two to four times longer than the body size of this species (Nogrady, 1993), so a very dense stem structure of aquatic plants can impede the movement of this animal. Therefore, in the collected material *Filinia longiseta* avoided elodeids, which confirms both its ecological requirements and the adaptations of its morphological build to live in the open water. However, in some cases (e.g. pond 2) an opposite pattern of spatial distribution of *Filinia* individuals was observed with highest densities attributed to littoral zone. High predation pressure in this small water body is probably the reason for obtaining such a discrepancy. Fish presence often induces horizontal migrations of numerous species of zooplankton towards aquatic plants stands (e.g. Scheffer, 1998), where effective refuge conditions for zooplankton can be found (Iglesias *et al*., 2007). Similar results were obtained by Narita *et al*. (1983) who found that in water bodies located within areas where land is subject to human activity *F. longiseta* revealed higher abundance among macrophyte stations.

There were six mid-forest ponds included in this study and only in one of them did *Filinia longiseta* occur in representative numbers (pond 14) and only in low densities, which can suggest that environmental conditions of this type of water body are below optimal requirements for the growth and development of *F. longiseta*. Small mid-forest ponds are often overshaded and this can lead to a lowering of the water temperature. *Filinia longiseta* is described as warm-stenotherm species, developing most abundant communities at a temperature of between 23 and 31 °C (Nogrady, 1993), so its occurrence is typical for the summer period in freshwaters of the temperate climatic zone (Duggan *et al*., 2001). Ejsmont-Karabin and Kuczyńska-Kippen (2001), who carried out research on urban ponds located within the city of Poznań, compared seasonal changes in the composition and abundance of rotifers and found that *Filinia longiseta* was recorded only from samples collected during the summer season. Moreover, long-term data from shallow eutrophic lakes (Andrew & Fitzsimons, 1992) have indicated that temperature changes have an immediate and direct influence on the density and occurrence of rotifers, including *F. longiseta*. The preference of *Filinia longiseta* towards the pelagic zone and its association with warm and unshaded water bodies was probably the reason for the absence of this species in some of the ponds as it occurred in only seven out of the nineteen investigated water bodies and only in ten out of thirty one studied stations.

Biometric analysis of specimens of *Filinia longiseta* showed that both parameters included in this study –the type of water body relating to different land-use as well as microhabitat type– significantly influenced *Filinia longiseta* size and the length of its setae. Individuals of this species were largest in ponds located within an anthropogenically modified landscape (irrespective of the type of habitat). This type of water body was also characterized by the highest content of total nitrogen and wide range of chlorophyll *a* concentrations. Human activity in the catchment area of a water body often influences the enrichment of the surface waters in nutrients which can positively correlate with the size structure of zooplankton (Wang *et al*., 2007). This may have been a reason for finding the largest individuals of this rotifer in anthropogenically modified ponds. *Filinia longiseta*, a typical eutrophic representative, which benefit from a high biomass of phytoplankton, can successfully occur in water bodies where blue-green algal blooms are present due to the fact that it is not susceptible to bacterial toxins (Čeirāns, 2007). The body dimensions of some individuals in two ponds (pond 3 and pond 14) may suggest coexistence *Filinia longiseta longiseta* with *Filinia longiseta limnetica* (Zacharias), but these species occur in different environments. *Filinia longiseta limnetica* is described as typical for large and deep lakes, so its presence in plate small water bodies is doubtful. Moreover, length analysis was conducted on preserved material, which may cause shrinking of the soft body. This probably has an influence on the proportion between ratios lateral setae and body length because spines are not changed by formalin. So any future research as regards the morphology of *F. longiseta* should be carried out on live specimens. The smallest specimens of *Filinia longiseta* were found in the mid-field ponds. As these ponds were characterised by a wide range of nutrient content, as well as of chlorophyll *a* concentrations, it seems that food conditions may have been responsible for the occurrence of the smallest individuals with shorter spines here. This concurs with the observation of Radwan *et al*. (2004), who stated that the body size and shape of many rotifer specimens is determined directly by food availability. *Filinia longiseta* feeds mainly on detritus, so the relationship with chlorophyll *a* concentration should not be taken into consideration in this study. The results obtained from Devetter (1998) revealed that *Filina longiseta* was negatively correlated with the smallest fraction of phytoplankton and also with predator species of *Cyclops*. *Filinia* specimens with longer spines were attributed to the forest ponds and also to anthropogenically changed water bodies, while the shortest spines were found in the mid-field ponds. Such a pattern of bristle length distribution may suggest strong pressure of invertebrate predators since the majority of these water bodies were without fish. Individuals of *Filinia longiseta* are consumed willingly by representatives of copepods, which will often prefer this rotifer species even to *Keratella cochlearis* (Williamson, 1987; Roche, 1990), which is believed to be the most common freshwater metazoan in the world (Lindstrom & Pejler, 1975; Koste *et al*., 1978) and often occurs in great numbers in a variety of water bodies (Kuczyńska-Kippen, 2007b;

Kuczyńska-Kippen, 2008). Furthermore, *Filinia* is often preyed on by the second-instar of *Chaoborus* (Moore, 1988) and also by predatory species of the large rotifer *Asplanchna*, whose presence may induce an increase in the length of the setae of *F. longiseta* individuals (Garza-Mouriño *et al*., 2005).

Comparing different types of habitat (irrespective of the investigated type of pond) discrepancies were found concerning the length of the rotifer body, lateral setae and caudal seta. The shortest lateral setae were noticed among the open water zone, contrary to two zones located within the aquatic plants –helophytes and nymphaeides. This seems to be contrary to expectations, as the longest bristle as an adaptation to pelagic life should be found in the open water area, where fish predation is strongest during day and rotifer appendages are usually longer as a mechanism to reduce the effectiveness of a predator's attack (Lampert & Sommer, 2001).

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